Design and Analysis of Algorithms (CSC311) – Spring 2017
Instructor: Prof. Mohamed Menai

Midterm Exam 1: Mar. 21, 2017 (5:00-6:30 PM).
Answer the questions in the spaces provided on the question sheets. If you run out of room for an answer, continue on the back of the page.
**Please, don't use pencils.**

Student Name:..... Student ID:.....

Section:.....

This exam has 4 questions, for a total of 20 points.

Question 1 ..... *4 points*

Prove or disprove that:

(a) [1 point] $n(n+1)/2 \in O(n^2)$

(b) [1 point] $n(n+1)/2 \in \Omega(n^2)$

(c) [1 point] $n(n+1)/2 \in \Theta(n^2)$

(d) [1 point] $n(n+1)/2 \in o(n^2)$

Question 2 ..... *6 points*

For each of the following functions, indicate the class $\Theta(g(n))$ the function belongs to. Use the simplest $g(n)$ possible in your answers.

(a) [2 points] $f(n) = (n^2+1)^{10}$

(b) [2 points] $f(n) = 2n\log(n+2)^2 + (n+2)^2\log(\frac{n}{2})$

(c) [2 points] $f(n) = \sqrt{10n^2+7n+3}$

Question 3 ..... *4 points*

Consider the following algorithm.

**Algorithm 1** Unknown($A[0..n-1]$) ▷ Input: An array $A[0..n-1]$ of $n$ real numbers

```
1: minval ← A[0]
2: maxval ← A[0]
3: for i ← 1, n − 1 do
4:     if A[i] < minval then
5:         minval ← A[i]
6:     end if
7:     if A[i] > maxval then
8:         maxval ← A[i]
9:     end if
10: end for
11: return maxval − minval
```

(a) [1 point] What does this algorithm compute?

(b) [1 point] What is its basic operation?

(c) [2 points] Give the best-case and worst-case running times of this algorithm in asymptotic notation.

Question 4 ..... *6 points*

Describe an algorithm that takes a list of $n$ positive integers and finds the location of the last even integer in the list, and returns 0 if there are no even integers in the list. Give

the best-case and worst-case running times of your algorithm in asymptotic notation.